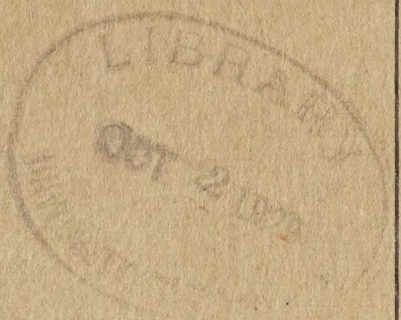
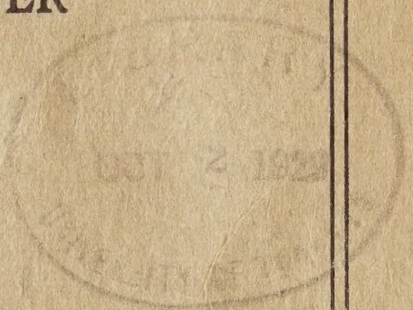
CANADA



A POPULAR ACCOUNT OF THE FISHES OF CANADA FROM THE LAMPREYS AND HAGFISHES TO THE VIPER FISHES INCLUSIVE



BY

ANDREW HALKETT

NATURALIST, FISHERIES BRANCH

DEPARTMENT OF MARINE AND FISHERIES

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
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Midway, as it were, with the innumerable hosts of invertebrates behind them and the higher vertebrates in front of them, the fishes hold rank among the great zoological lineages. No sharp line demarks them entirely from certain batrachians, but they may be characterized as vertebrates so organized as to be enabled to pass the whole period of their existence by living and respiring in water. This does not imply, as we shall see, that no fishes exist which cannot for a time live, and even breathe, out of water; nor does it imply that no other vertebrates do not pass the whole or part of their lives under water, for some batrachians (for instance certain salamanders, and the larvæ of frogs and toads which are commonly called tadpoles) do.

Some one, somewhere, has remarked that it would seem as if this planet had been especially created for fishes, and indeed when we consider the enormous size of some of them; the prodigious schools or shoals of others; the fact that multitudes of kinds inhabit the ocean, severally, from its surface to its abysmal depths, and at its shores and estuaries, whilst others of brilliant hues dwell among coral reefs; that lakes, rivers, and streams teem with very varied members of the finny tribe; that a few even dwell in darkness in subterranean rivers; and furthermore that there are some thirteen thousand species of known fishes this idea might almost be conceded.

Their function of breathing under water leads to a consideration of their respiratory organs: that is the gills. These organs are not homologous to the lungs of other vertebrates, and the lung of a dipnoid fish is an organ altogether independent of its gills by which it ordinarily breathes. The gills are variously modified: in lampreys, sharks, and skates they lead to a number of external openings on either side, but in the higher fishes they are usually in folds, protected by bony opercular covers, forming a pair of clefts, one on either side. The water, charged with free oxygen, enters the mouth of the fish, passes on to the gills, and is then expelled through the clefts; and the function of the gills is to arrest the oxygen held in the water in order to oxygenate the blood.

The fins of fishes are of two different kinds: the vertical and the paired. The vertical fin may be, but more rarely, a continuity, commencing on the back, proceeding around the tail, and terminating at the vent; or it may be, as is usually the case, broken up into dorsal, caudal and anal fins. Some fishes, salmonoids for instance, besides these possess a peculiarly modified fleshy fin, a second dorsal, without rays, called the adipose. The paired fins are the limbs of fishes. The pectorals answer to the front pair, the ventrals to the hind pair.

The situation of the pectorals is more constant than is the case with the ventrals. They are more or less, as a rule, placed right behind the gill clefts, but they may be high up, midway, or low down. The situation of the ventrals differs in the several groups. In sharks, herrings, salmon, carps, etc., they are abdominal or far behind the pectorals; in many they are thoracic or placed below the pectorals; whilst in others, the codfishes for instance, they are jugular or in front of the pectorals.

A few fishes have no paired fins, but the absence of ventral fins is of more frequent occurrence than the absence of pectoral. The ventrals are wanting in eels, in the adult swordfish, in certain blennies, in the pipe-fishes and sea-horses, and many others.

The fin rays, either of the vertical or paired fins, are variously constructed, but whether simple, articulated, branched or forming spines, are always associated with the piscine or fish skeleton, and the presence or absence of this or that kind of ray has much to do with determining the relationships of fishes.

The bodies of fishes are usually covered with scales, which in the fishes of more recent times, as geological time is reckoned, are mostly distinguishable as cycloid or smooth and ctenoid or combed. Another form of scale, more pertaining to fishes of ancient times than to fishes of to-day, is known as ganoid. This form is somewhat lozenge shaped, hard, and enamelled, and the scales articulate together, instead of overlapping like shingles on a roof as cycloid and ctenoid scales do. Exceedingly few extant fishes have ganoid scales, and out of the fishes indigenous to Canada the gar-pike alone possesses them.

Some fishes are scaleless, whilst certain fishes devoid of true scales have the body entirely or partially covered with protruberances, scutes, spines, or plates. The bodies of sharks are covered with rough wart-like tubercles which have been termed placoid scales. These tubercles are generally numerous and minute, rendering the skin of a shark granular. Sturgeons possess a series of scutes or bucklers in five rows, each buckler terminating in a spine, and there are small scattered or irregular knobs on the skin. There are fishes, mostly of the tropics, for instance the porcupine fishes, covered and protected with long and sharp spines; and others, for instance the trunk fishes, armoured in bony plates.

Along the sides of most fishes are lines, generally one on either side, called the lateral lines, and the scales which cover them are perforated, forming outlets to what are known as the muciferous ducts, but the lateral lines are variously modified, and in some fishes do not exist at all. The herring for example has no lateral line.

The great majority of fishes are oviparous or extrude eggs which subsequent to their extrusion are fertilized in the water, but the eggs in a small minority of fishes are fertilized within the parent fish. The latter mode is the case in sharks, skates, and chimaeras, and in a very few, comparatively, of the true-boned fishes. The dogfish and many other sharks bring forth their young alive, and are therefore termed viviparous. Among the true-boned fishes some of the blennies, the blind-fish of Kentucky caves, the snapper or rose-fish, the surf-fishes, and a number of others are viviparous. It should not be supposed, however, although the instances in which fishes bring forth their young alive differ in degree, that the phenomenon conforms in essential particulars to the viviparous nature of the placental mammals. The term ovo-viviparous is therefore sometimes employed in distinguishing them from fishes which are strictly oviparous. In some, as is the case with the dogfish, the egg yolk remains attached to the young liberated fish, supplying it with nutriment until ultimately the substance is absorbed into the little fish's own system. Also, it does not follow that viviparous fishes are necessarily higher in the scale of fish life than some oviparous fishes are. Some of them it is true are high in the scale, but there are oviparous fishes just as high. Oviparity or viviparity therefore among fishes is not a fundamental but a secondary matter; and there are fishes that are structurally closely related, in some of which the one mode of reproduction and in others the other mode pertains. Again, the viviparous sharks in the scale of fish life are far below the highly specialized oviparous mackerel, tunny, and swordfish.

In a popular description fishes may conveniently be divided into those which have the skeleton composed of cartilage and those which have the skeleton ossified or composed of true bone. In some of the cartilaginous fishes the vertebrae are hardened through calcification or the deposit of insoluble lime salts, but none are composed of true bone. These fishes are far fewer in

number and more primitive in their structure than the generality of true boned fishes are, and an aim in this descriptive work in classifying our fishes is, as much as possible, to trace step by step the varied modifications that were undergone in the evolving of higher forms from lower. There is no linear order to be observed in this for there is a branching forth in different directions, so that in systematizing the various great groups there is no hard and fast rule to go by. Besides there are fishes belonging to the higher groups that instead of advancing have retrograded. The great thing to keep in mind then in the classification of fishes in relationship, so that starting with the most primitive forms and for the most part proceeding from lower to higher forms, an adequate conception of how the fishes of the entire class are related is to be gained.

I. CARTILAGINOUS FISHES

These as they pertain to the extant fishes indigenous to Canada, embrace the lampreys and hagfishes, the selachians or sharks and rays, the chimaeras, and the sturgeons and paddle fishes.

1. LAMPREYS AND HAGFISHES

With these we start at the very foot of the piscine scale, and some would even exclude them from the fishes altogether. In form they are elongated or eel-shaped, and often mistaken for eels, with which however they have no relationship. They have no jaws, no paired fins, no ribs, and they are scaleless. They possess vertical fins feebly rayed. In the lampreys the mouth is preceded by a funnel shaped suctorial disc placed downwards, by which they attach themselves to other fishes and rasp the flesh off with their teeth. The teeth which are conical or cusped in shape are placed on the inner part of the funnel and also on the tongue. In the hagfishes there is no pronounced disc, and as they are unmitigated parasites, for they bore their way right into the bodies of their victims, their heads are small and terminate in front as a snout furnished with a number of tentacles or feelers. Between the eyes in the lampreys there is a single median nostril, but in the hagfishes the eyes are degenerate and the single nostril is placed in front of the mouth. World wide, there are some eight genera of lampreys with about twenty species, and four of the genera are indigenous to Canada; but the genera and species of hagfishes are few. There are seven gill apertures on either side in the lampreys which are placed behind the head. There are variations in the number of gill apertures in the hagfishes, and the number not only differs in the species but also sometimes in individuals of the same species. The eggs of lampreys are small, whilst those of hagfishes are large and encased in horny capsules provided with filaments at the poles by which the capsules are linked together.

The Great Sea Lamprey *(Petromyzon marinus)*

This marine lamprey is anadromous or ascends streams in order to spawn. In shape it is cylindrical in the front part of the body and compressed in the hinder part. In colour it is bluish brown generally mottled with blackish on the upper parts, and whitish underneath. It attains a length of from two to three feet. It has two dorsal fins, but the caudal is continuous with the second dorsal, so that together the two constitute one unbroken vertical fin. It is indigenous to the Atlantic coasts of North America and Europe and is reputed also to occur on the west coast of Africa and in the Mediterranean. It occurs on coasts of the Maritime Provinces and in Gaspé bay, and in its American range extends southward to Chesapeake bay.

The Silvery Lamprey *(Ichthyomyzon concolor)*

This species inhabits lakes and rivers and in the spring time ascends small streams. It occurs in the St. Lawrence river and Great Lakes region and also in the upper Mississippi valley, and was recorded by Preble in 1900 as occurring in Hill river, Hudson bay region. It reaches a length of about a foot. In colour it is silvery, being bluish and sometimes spotted with blue above, and over each gill aperture there is a dusky spot.

Mention is here made of the northern lamprey *(Ichthyomyzon castaneus)* locally known from certain states of the Mississippi valley, but which was recorded by Thompson Seton in 1898 as occurring in the Assiniboine river, Portage la Prairie, Manitoba. It differs from the silvery lamprey in a few particulars, such as in colour, in the length of the head, and in the number of dental cusps.

The Three-Toothed Lamprey *(Entosphenus tridentatus)*

This is an anadromous species of the Pacific coast of North America, its range being from the Aleutian islands to southern California, so that it is indigenous to British Columbia. It has two dorsal fins, is usually uniform dark brown in colour, and reaches a length of about a foot and a half.

The Brook Lamprey *(Lampetra aurea)*

This lamprey mostly abounds in streams. A possible record is that of Richardson in 1836 of a specimen of a lamprey found attached to an inconnu in Great Slave lake. In any case it is a species of the far north, being indigenous to the Yukon river and streams of Alaska and Kamchatka. It receives its technical specific name *aurea* on account of its under golden colour. It is of plumbeous or leaden colour above. It is about a foot in length, and is closely related to a fresh water lamprey *(Lampetra fluviatilis)* of Europe.

The Brook Lamprey *(Lampetra cibaria)*

The vernacular name brook lamprey is also bestowed on this species, and it also is a river lamprey. It ranges from British Columbia southward to the Sacramento river, California. It occurs in the Fraser river and is quite common in northern rivers and streams. It attains a length of about eight inches. It is plumbeous in colour and silvery on the sides.

The Small Black Lamprey *(Lampetra wilderi)*

This lamprey is indigenous to the State of New York and the Great Lakes region westward and embraces the Ohio and Mississippi valleys. Nash had the impression he had found it in our waters, and wrote: "I am not positive as to the occurrence of this species in our waters, though I have often taken a small Lamprey in the northern and western streams of Ontario and in the rivers of Manitoba which I believe to be the Brook Lamprey." (The name "brook lamprey" is also applied to the small black lamprey, which was the species Nash had in mind.) This species may reach a length of about ten inches, and is bluish black in colour above and silvery beneath. It mostly abounds in rivers and ascends small streams to spawn.

The American Hagfish *(Myxine limosa)*

A thing of significance in regard to this hagfish is, that instead of having seven pairs of gill apertures as the lampreys have, there is a single pair, one aperture being on each side, placed far back near the extremity of the body and therefore far from the head, to which six pairs of internal gill sacs in common lead. This is doubtless a great provision of nature on behalf of this burrowing, parasitic creature. In colour it is bluish above and whitish below. It may attain a length of about two feet. It is closely related to the European hagfish *(Myxine glutinosa)*, and its range is the coast of North America, embracing the Maritime Provinces and extending southward as far as cape Cod.

The Pacific Hagfish *(Polistotrema stouti)*

Ordinarily this species is known as the California hagfish, and it ranges from the coast of Vancouver Island southward to the coast of California. It differs very much in the gill structure from the preceding species. Instead of a single pair of gill apertures there are numerous small pairs which in individuals differ considerably in number, but they may be placed at about twelve apertures on each side; and are situated much further back on the body, and away from the head, than they are in the lampreys. The colour of this hag is blackish purple, being paler below; and its length is about fourteen inches.

2. SELACHIANS: SHARK AND RAYS

All the extant sharks have five gill apertures on each side, with a few exceptions in which there are six or seven; and all the rays have five on each side. In the males the ventral fins are provided with a pair of claspers. All the selachians possess paired fins. None of the rays have an anal fin. The rays differ from the sharks in their depressed form and greatly expanded pectoral fins, in having the eyes placed on the top of the head, whilst the mouth and gill apertures are situated on the ventral or under part of the body. Nevertheless there is such a transition from the sharks to the rays, through gradations between the two groups so that they can very naturally be considered together under the common heading Selachians.

The Cow Shark *(Notorhynchus maculatus)*

The known range of this shark is from the coast of California to that of the state of Washington, but as it probably occurs also, or is likely to appear, in British Columbian waters it is mentioned in this list. It differs from the great majority of existing sharks in having seven pairs of gill apertures instead of the usual five. It is slender and elongated in form with a correspondingly long tail, is gray in colour variegated with black spots, and has a single dorsal fin. It is viviparous or brings forth its young alive.

The Shovel-nosed Shark *(Hexanchus corinus)*

This species has six pairs of gill apertures instead of the usual five. It is rather elongated in shape, the oblong head and front part of the body being depressed, whilst it gradually tapers to the tail. It has a single dorsal fin nearly opposite to which is the anal fin and the two are much alike in general form. The snout projects and the tail is long. In colour it is black with a lateral grayish streak. It brings forth its young alive. It ranges from Vancouver island and Puget sound southward to the bay of Monterey, California.

The Cat Shark or Swell Shark *(Catulus brunneus)*

This is apparently a very rare species. At the time of the publication of Jordan and Evermann's "Fishes of North and Middle America", 1896, only one specimen was known, which was a female with mature eggs, and which was obtained in deep water in the gulf of California. Owing to the possession of a very young specimen in the Provincial Museum, Victoria, obtained since then at Nanaimo, Vancouver island, this rare shark is mentioned in this work. This species of cat shark is said to be a uniform brown in colour, the snout and the edges of the fins being blackish, and to be twenty inches long.

The Oil Shark or Tope *(Galeorhinus zyopterus)*

This shark has been recorded from British Columbia. Ordinarily it ranges from the coast of California from San Francisco to Cerros island, Lower California, Mexico. It is some six feet in length, and is dusky gray in general colour with black on the dorsal and pectoral fins and on the tip of the caudal. It has two dorsal fins, the first of which is placed about midway between the pectorals and ventrals, and the second, which is much smaller, is placed opposite the correspondingly small anal. The mouth is crescent shaped. It is a close relation of the European tope *(Galeorhinus galeus)*. It brings forth its young alive. The Chinese turn it to account by making soup from its gelatinous fin rays, and oil is extracted from its liver.

The Great Blue Shark *(Prionace glauca)*

This large voracious shark is very widely distributed. It occurs on coasts of the Maritime Provinces and banks off Newfoundland, and has occasionally been found at coasts of California. It was recorded by Valenciennes in 1838 from the coast of Brazil. It is, however, more common in European seas than on American coasts. It inhabits the Mediterranean, frequents coasts of the British islands, and according to Yarrell, 1859, has been known to wander as far north as the coast of Zetland. It is slender in form and swift in motion, has two dorsal fins, is bluish gray in colour above and paler below, may reach a length of about twenty-five feet, and brings forth its young alive.

The Thresher *(Alopias vulpes)*

This is a very remarkable fish, and stands uniquely alone among the sharks. It has the upper lobe of the caudal fin enormously developed, the tail being muscular and long, with which it whips or thrashes the victims upon which it preys or splashes the water so as to round them up. It is said to be an inveterate enemy to whales (although some dispute this matter purely as a story) and is very destructive to herrings, pilchards and sprats. Its tail is at least as long as the rest of its body, and altogether it reaches a length of some fifteen feet. It is very cosmopolitan in the seas, frequenting both the Atlantic and Pacific oceans; it occurs at coasts of the Maritime Provinces, and according to Knight in his "Fishes of Nova Scotia", "it is a great enemy to the small whales in the gulf of St. Lawrence"; it frequents British coasts, is common in the Mediterranean, and according to Günther, 1880, has been recorded from the coast of New Zealand.

The Porbeagle or Mackerel Shark *(Lamna cornubica)*

This ferocious shark is very destructive to mackerel and salmon, and attains a length of some ten feet. It is spindle shaped, the snout being pointed and the body tapering to the tail. Its first dorsal fin is large and high, and the second

dorsal and anal are very small. The pectorals, which are placed under the first dorsal, are large and the ventrals moderately small. The caudal fin is lunate or crescent shaped. It is bluish gray in colour. It frequents both the North Atlantic and the North Pacific, occurs in the gulf of St. Lawrence and coasts of the Maritime Provinces, is occasional on New England coasts and further south, on the coast of California, on coasts of the British islands, including the Orkneys, and Günther, 1880, wrote: "Haast has found this species also off the coast of New Zealand."

The Great White Shark *(Carcharodon carcharias)*

This species is mentioned as it occasionally occurs both on Atlantic and Pacific coasts of North America, but I know of no record of its occurrence on Canadian coasts. Still it is a shark of temperate as well as of tropical seas and is therefore quite likely to turn up at our own coasts. It is a very large shark of about thirty feet in length, very voracious, and is otherwise known as the man-eater shark. In colour it is leaden gray with black on the edges and tips of the pectoral fins.

The Basking Shark *(Cetorhinus maximus)*

This is the largest of all existing fishes, attaining a length of about forty feet. At the same time, to man, it is a harmless shark, and receives its name by leisurely basking in the sun. Its food consists of small fishes and other small marine organisms. The first dorsal fin, which is high, is situated between the pectorals and the ventrals. The second dorsal and the anal are small. Its gill apertures are of great vertical length and extend all the way between the dorsal and ventral surfaces. It occurs on coasts of the Maritime Provinces and British Columbia, ranging from arctic seas, southward on the American sides to Virginia and California and on the European side to Portugal and the Mediterranean; whilst according to Bridge, "although generally described as a northern form *Cetorhinus* is known to occur in Australian waters."

The Picked Dogfish *(Squalus acanthias)*

This species although a very small shark, only attaining a maximum length of some three feet, and its congener the next to be considered, are the most harmful and troublesome to our fisherman of all the sharks, of which, world wide, there are said to be about a hundred and forty different kinds known. These dogfishes are extremely destructive. Both species often move in great schools, and the havoc they play among schools of economic fishes is enormous. They are also very destructive to fish nets. The picked dogfish is of slender form, it has two dorsal fins each of which is furnished in front with a spine, and it has no anal fin. It is a slate colour above, and the young has whitish spots which often do not altogether disappear in the adult, and it is pale beneath. It brings forth its young alive. It is widely distributed on both coasts of the north Atlantic, probably extending from the coast of Labrador southward to Cuba on the American side, and is common on coasts of the British Islands and other European coasts.

The Pacific Dogfish *(Squalus sucklii)*

This species is commonly known as the California dogfish. It is very similar to the preceding in structure and habits. Its spines are lower. In colour it is gray, often with black on the edges of the fins, and the young has white spots on the back which generally disappear in the adult. It is indigenous to British

Columbia, and ranges from the Aleutian Islands to the coast of California. A dogfish off the coast of Chile, named by Molina as *Squalus fernandinus,* is perhaps referable to this species.

Mention is here made of two species of spiny dogfishes which occur at the fishing banks off Nova Scotia. They are technically known as *Centroscymnus coelolepis* and *Centroscyllium fabricii.* The former is recorded by Jones in his "List of Fishes of Nova Scotia", 1897, to be abundant on those banks, and it occurs also off the coast of Portugal and adjacent coasts. It is blackish brown in colour. The latter besides occurring at those fishing banks is indigenous to arctic seas and coasts of Greenland, and according to Bridge is found "in the opposite hemisphere at the Falkland islands." It is black in colour. Both species have at times been taken off Gloucester, Massachusetts, the former at least in deep water. The spines in the former are covered by the skin.

The Sleeper Shark or Greenland Shark *(Somniosus microcephalus)*

This large, clumsy shark, reaches a length of some twenty six feet. All its fins are small and it has no anal fin. It is oviparous, and unlike other oviparous sharks, its eggs are not encased in horny capsules, but are soft and they are demersal or sink to the bottom of the sea. It is reputed to be a great enemy to whales, biting off great pieces of their flesh. It is a shark of northern seas. Indigenous to arctic seas it extends on the American sides southward to cape Cod and the coast of Oregon, and on the European side southward to the coast of France. A specimen examined by Jones "was taken off Halifax harbour in February 1863", and an individual from opposite the mouth of the Saguenay river, province of Quebec, was recorded by Whiteaves in 1886. According to Bridge " numerous instances are recorded of its capture off the coast of Great Britain, especially in northern waters." It has also been recorded from the coast of Labrador.

Grading from the sharks to the rays are a number of intermediate forms, which however are not really indigenous to Canadian waters. The angel fish *(Squatina squatina)* is a connecting link, having affinities with the sharks and placed with them, but agreeing more or less with the rays in the depression of the body; the expanded pectoral fins, although these are not adherent except of course at their bases to the sides; and in certain other particulars. Another singular link pertains to two separate kinds of sawfishes, one kind of which *(Pristiophorus),* chiefly owing to the lateral location of the gill apertures, is placed with the sharks, whilst the other kind, or the sawfishes proper *(Pristis),* is placed with the rays, as like them the gill apertures are located on the under part of the body. The bodies in these nevertheless, although in a measure depressed, are elongated like those of the sharks, and the form and position of the fins are more as with them. Also between the sawfishes and the typical rays, there is a gradation in the guitar fishes *(Rhinobatus)* the body in these being depressed and the pectoral fins moderately expanded, so that they more closely approach the typical rays.

The Common Sawfish *(Pristis pectinatus)*

The occurrence of any animal or plant once, either on land or in water of any country entitles its inclusion ever after into the fauna or flora of that country. Therefore the occurrence in Nova Scotia of a single specimen of sawfish, although very long ago, described by Denys in 1672 (under the name L'espadon which means the swordfish which it is not) entitles its admission into the fauna of Canada, and to call for our attention. In so far as available records go this is the only exception to what is stated above concerning fishes not really indi-

genous to Canada. Denys' naive account was written in old French, and is here (quoted after Doctor Cox of Fredericton University) transcribed, and followed with an English translation rendered by Mr. Alexis Demers, translator of the Federal Fisheries.

"L'espadon est un poisson gros comme une vache. de six à huit piéds de longueur, qui va en diminuant vers la queuë; il a sur le nez un espadon, dont il prend le nom, qui est long d'environs trois piéds. large d'environs quatre bon doigts; il y a de deux costez de cet espadon des pointes longues d'un pouce, de pareille distance les une des autres, et va étraissessant vers le bout; il ne plye point et est dur et fort roide." L'Histoire Naturelle, par Nicholas Denys, Paris, 1672.

Translation

"The Swordfish is a fish of the size of a cow, measuring six to eight feet in length and the body of which terminates at the tail in a tapering form; its nose terminates in a sword, hence its name. That sword is of about three feet in length and of about four fingers in width; on both sides of that sword there are stings of one inch in length, of the same distance from each other and terminating in a tapering form. That sword does not bend and it is hard and rigid". Natural History, by Nicholas Denys, Paris, 1672.

The common sawfish, in keeping with the few other species of the true sawfishes, although as already mentioned shark-like in shape and in the form and position of the fins, is really related to the rays. It has as in the typical rays the gill apertures, five in number on either side, placed on the under part of the body, and like them it has no anal fin, which most of the sharks have. This species ordinarily occurs at the West Indies, the coast of Florida, the gulf of Mexico, ascends the lower Mississippi river, and extends as far north as North Carolina. It has a prolongation of the upper part of the skull, somewhat as in the swordfish, only that in its case this long and flattened blade is beset on each side with a row of strong and pointed teeth. This fish may attain a length of as much as twenty feet.

The Common Skate *(Raja erinacea)*

This is a small skate with a maximum length of about two feet. It is light brown in colour with small spots of a darker brown. It occurs in the gulf of St. Lawrence, Gaspé bay, coasts of the Maritime Provinces, and extends southward to the coast of Virginia.

The Big Skate *(Raja ocellata)*

This species attains a length of about three feet. It also is light brown in colour with darker spots, and there is on each pectoral fin, as a rule, an eye-like marking with a darker border and in the centre a dark spot—hence the specific technical name *ocellata*. It is indigenous to the Atlantic coast from the Maritime Provinces to the state of New York.

The Starry Ray *(Raja radiata)*

This species is distinguishable from most of the others by the possession of spinous plates placed on various parts of the back in addition to the spines common to most species of skates. The males also have sharp spines on the pectoral fins. It is pale brown in colour with a tinge of orange, and reaches a length of about two feet. It occurs in the Maritime Provinces, and probably extends as far south as coasts of northern United States on the Atlantic side, and has also been reported to occur at the coast of Greenland. On the European side of the north Atlantic it is common. It is indigenous to coasts of the British islands, the coast of Norway, the Baltic, and Iceland.

The Barn-door Skate *(Raja laevis)*

This is a very large species, attaining a length of about four feet. It is rather smooth as its spines are very small and few in number. In colour it is brownish generally with paler spots. It is indigenous to the Maritime Provinces and the coast of the United States south to the coast of Florida.

The Big-Skate-of-California *(Raja binoculata)*

This is the giant among the skates of coasts of North America. It attains a length of six feet. It occurs at the coast of British Columbia, and ranges from the coast of Alaska to the bay of Monterey, California. Its colour is brown and it is covered with pale spots. At the base of each pectoral fin there is an eye-like spot, hence the specific technical name *binoculata.*

The Deep Sea Ray *(Raja abyssicola)*

In my " Check List of the Fishes of the Dominion " I bestowed on this new species the vernacular name of deep sea ray. The only specimen known at the time of the publication of that work (1913) was a male obtained at a depth of 1,588 fathoms off the Queen Charlotte islands, British Columbia, nor have I heard of a record of any other specimen since. A footnote in the above-mentioned work is here quoted verbatim:—

" No ray was ever found at any such depth as this before. A ray from a depth of 565 fathoms is included in the list of deep-sea fishes obtained by the dredgings of the *Challenger* (Günther); and '*R. mamillidens,* a uniform jet-black species, has been obtained from a depth of 597 fathoms in the bay of Bengal' (Bridge), but so far as available records show none have been obtained at a greater depth than some 600 fathoms except this one."

The specimen of this fish from the depths was described by Jordan and Evermann in their great work " The Fishes of North and Middle America " as being 45 inches long, and coloured " nearly uniform sooty brown on both upper and lower sides, with a few scattered black spots above ".

Of other species of rays recorded from British Columbia coasts, but without vernacular names, are *Raja rhina* and *Raja stellulata.* Each attains a length of about two and a half feet. The former is of a light brown colour with a dark ring at the base of each pectoral fin, and it ranges from the coast of Alaska southward to the bay of Monterey, California. The latter is brown with various lighter and darker markings, spots, and rings. It ranges from Unalaska, Aleutian islands, southward to Santa Barbara, California.

3. CHIMAERAS

On reaching the chimaeras we meet for the first time something of the nature of an operculum, which is an external covering protecting the gills. We have therefore no longer to treat of fishes with separate gill apertures such as lampreys, sharks and rays have. Nevertheless they belong to the cartilaginous fishes, and have many affinities with the selachians. Like them, their eggs are fertilized before extrusion, and are enclosed in capsules as in the rays and almost all of the oviparous sharks. They have two dorsal fins, the first of which is short and high and furnished in front with a strong spine. The pectoral fins are pronounced and placed low, and more or less right under the first dorsal. In the males the ventral fins are provided with claspers as in the sharks and rays. The existing chimaeras are few in number, and little represented in Canadian waters. But it may be worthy of mention that a specimen of a chimaera (*Chimaera affinis*) was obtained on the southeastern portion of La Have bank, which is some distance beyond the three-mile limit off the coast of Nova Scotia. This species is said to occur on the American coast as far south as cape Cod, and is otherwise known from the Gulf stream and from off the coast of Portugal. A species of chimaera indigenous to British Columbia is the following:—

The Ratfish *(Hydrolagus colliei)*

According to Bridge this chimaera is " especially plentiful off southeastern Alaska, and about the wharves at Esquimalt ". It ranges southward to the bay of Monterey, California. It swims near the surface of the water, and is there-

fore unlike the chimaeras in general which frequent the depths. It reaches a length of about two feet, is grayish in colour with white spots, and the edges of the dorsal fins are blackish. On the head there is a spur-like organ in the male.

4. STURGEONS AND PADDLE FISHES

These fishes are degenerate descendants of a very ancient primitive stock, going back to the Lower Devonian epoch. Yet in certain respects there is in them a nearer approach to the true-boned fishes than there is in any of those to which our attention has so far been drawn. The opercular cover becomes more pronounced. They are all oviparous, and their eggs are small. They have no true scales. The skeleton is essentially cartilaginous, but the sturgeons have the head protected with bony plates sutured together, and they have no teeth. They have also in front of the suctorial mouth four barbels or feelers placed on the under part of the long snout, on the sides five rows of bony scutes, and the first ray of each pectoral fin is strong and spine-like. Concerning the paddle fishes there are only two extant species known: *Psephurus gladius* of the Hoang Ho and Yangtse rivers of China, and a North American species to be described in its place.

The Common Sturgeon *(Acipenser sturio oxyrhynchus)*

This is a sub-species (hence the trinomial) of the common sturgeon (*A. sturio*) of Europe, from which it only slightly differs. It is anadromous or spawns in fresh water. It is indigenous to coasts of the Maritime Provinces and the St. Lawrence river and tributaries. But, although a coastwise sturgeon, strange to say it was reported by Eigenmann in 1894 from Manitoba and from northern lakes of the interior. Its range in the United States is from Maine to South Carolina. It is greyish in colour, and may reach a great size, but its maximum length is hard to determine.

The Lake Sturgeon *(Acipenser rubicundus)*

This sturgeon attains a length of about six feet. In colour it is dark olive, being reddish or paler on the sides, and frequently has blackish spots. It is an inland species, indigenous to the provinces of Ontario and Quebec, occurring in the St. Lawrence river and lake of the Woods. It also occurs in prairie provinces, and has been recorded from Labrador, Hudson bay, and some other parts of the far north. In the United States it is indigenous to the Mississippi and Ohio rivers and tributary waters.

The Short-Nosed Sturgeon *(Acipenser brevirostrum)*

This species was recorded by Fortin in 1864 from the St. Lawrence river and tributaries. It ranges in the United States waters ordinarily from cape Cod to Florida, and has also been reported from the coast of Texas. It is anadromous, entering the larger rivers and estuaries. In colour it is dusky above and paler beneath.

The White Sturgeon *(Acipenser transmontanus)*

This very large sturgeon, which, so it is said, may attain a weight of 600 pounds, occurs in British Columbian waters and ascends the Fraser river. It is anadromous, or remains permanently in fresh water and was recorded by Richardson in 1836 from Pine Island lake and the Saskatchewan river. It also ascends the Columbia and Sacramento rivers, and its coastwise range extends from Alaska to Monterey, California. It is a dark gray in colour.

The Green Sturgeon *(Acipenser medirostris)*

This sturgeon frequents the sea or brackish water, but seldom enters rivers beyond their mouths. It occurs on coasts of British Columbia, its reputed range being from San Francisco northward, but is said by Jordan and Evermann not to be common beyond the straits of Fuga. Its ground colour is olive green, and it has a few olive stripes.

The Paddle Fish *(Polyodon spathula)*

The paddlefish is exceedingly rare in Canada. Two specimens, one of which is now in the custody of the Fish Cultural Branch of the Federal Fisheries Department, Ottawa, were obtained from lake Huron near Sarnia, Ontario, a long time ago, and according to Prince "Old fishermen near Point Edward on the Lambton county shore vaguely refer to other specimens occurring in lake Huron." Other records are, a specimen from Spanish river, district of Sudbury, and a specimen from lake Helen, Nipigon river. It has also been known to occur in lake Erie, and there are a few records of over a century ago of its having been found in lake Ontario and the Ohio river. It is still plentiful in the Mississippi valley and in waters of southern United States.

This is a remarkable fish. It receives its name by reason of a long paddle-like blade at the front of the head, which is flat and to a degree flexible and sensitive. On the under part of the blade there are four rudimentary feelers or barbels, and it possesses very small teeth. It has also a long tapering flap, produced beyond the opercular covering of the gills, and its skin is smooth. It may reach a length of about six feet, and is olivaceous in colour.

II. TRUE-BONED FISHES

These embrace the vast majority of contemporaneous fishes, of which majority there are probably, world wide, somewhere about twelve thousand different species known. The value of many of them to man is incalculable: "the harvest of the sea" yielding herrings, mackerels, codfishes, salmonoids, and numerous others, which fishermen jeopardize their lives in procuring; whilst the angler beguiles his leisure hours beside some stream or lake, tempting a silvery trout or gamey bass with baited hook. The skeleton of these is essentially ossified, although there are a few in which there is the retention of certain cartilaginous elements. This being a popular work, technicalities are as much as possible avoided, but for any who might desire to go more deeply into the study of ichthyology, a short outline of the main features of the teleost cranium or skull is here introduced. Furthermore there is an advantage in seeking to identify to what species or group a fish in particular belongs in possessing even an elementary knowledge of the bones of the head. Such bones as the maxillaries, the vomer, and the opercular bones are very helpful in this respect; and these and a number of other bones can be examined without cutting into the head at all. The outline presented of the structure of the teleost cranium, is the outcome of facts ascertained in personally dissecting many a fish's head, and in, step by step, guiding myself along by reference to authoritative literature on the subject.

At the base of the skull is the *basioccipital.* It has a concavity (filled in conjunction with that of the first vertebra to which it attaches, with a gelatinous substance) and supports a pair of bones, one on either side, called the *exoccipitals,* resting upon which is another pair called the *paroccipitals,* and crowning the

whole is a bone, often crested, called the *supraoccipital.* These five bones, viz.: the exoccipitals, the paroccipitals and the supraoccipital, form an arch, which rests upon the basioccipital, and the aperture, thus formed, through which the nerve mass passes to the brain is known as the *foramen magnum.* Connected with each exoccipital is a partially ossified or gristly ear-capsule, called the *petrosal* (=the *squamosal*) in which in each is lodged an *otolith.* The floor of the cranium consists of the basioccipital and two other bones called the basisphenoid and the vomer. The *basisphenoid* is a long and narrow bone, into which the basioccipital posteriorly, and the vomer anteriorly are wedged. Upon it are supported a pair of bones called the *alisphenoids,* on which are the *mastoids,* over and above which, in turn, are the *parietals.* In front of these are a pair of small plates: the *orbitosphenoids,* adjoining which are the *postfrontals,* and placed on the roof of the cranium a pair of bones called the *frontals.* At the front part of the skull is the *vomer,* often toothed, over which are the *prefrontals,* and over and above these are the *nasals.* Situated also at the front part of the skull is a pair of bones called the *turbinals.* In front of the cranium are two pairs of bones, one the *maxillaries,* the other the *premaxillaries,* which often bear teeth, and help to form the upper jaw. The gills, on either side, are covered and protected by the opercular flap, which consists of the *operculum,* a scale like, triangular shaped bone; which is joined to the praeoperculum and hyomandibular; the *subopercului,* an oblong bone placed below the operculum; the *interoperculum,* often an oval shaped bone, placed below the praeoperculum, and attached by ligament to the mandible; and the *praeoperculum,* a strong, curved, angular bone, anterior to the other pieces, which not only serves as a support to the flap, but forms a part of the mandibular arch. This bone is often serrated along the edge of its posterior margin. Besides the praeoperculum, the bones of the mandibular arch or suspensorium, consist of the *hyomandibular* (=the *epitympanic* or *temporal*), which articulates with the postfrontal and mastoid bones of the cranium, and with the operculum; the *metapterygoid* (=the *pretympanic*) a flat shaped bone; the *mesotympanic* (=the *symplectic*) a narrow styliform bone, placed behind the metapterygoid, and between the hyomandibular and quadrate; and the *quadrate* (=the *hypotympanic*) a triangular bone, with a condyle to which the mandible is attached. The bones of the mandibular arch, then, form a chain connecting the mandible with the cranium. Bridging the space between this arch and the prefrontal and vomer, are the following bones: the *entopterygoid* (=the *mesopterygoid*) a thin, and sometimes, semi-transparent bone, which is joined to the pterygoid and palatine, and which, moreover, forms a floor of the orbit; the *pterygoid,* a long and slender sickle shaped bone, joined to the anterior part of the quadrate, and reaching the palatine; and the *palatine,* also often beset with teeth, and which adjoins the prefrontal and vomer. These bones are known as the palatine-arch. A chain of bones called the *infraorbital ring* is arranged around the lower border of the orbit, the first of which is large, and bears the name of the *praeorbital,* and the others, a few in number, are called the *sub-orbitals.* The bones of the mandible, or those of the lower jaw, consist on either side of the *dentary,* a strong and as the name implies, a tooth bearing bone, deeply hollowed out for the reception of the triangular process of the articulary; the *articulary,* which is connected by ligament to the maxillary, and which articulates by a concavity with the quadrate; and the *angular,* a small superficial bone. The dentaries are united by symphysis. Within the excavation of the dentary is an unossified cylindrical process known as *meckle's cartilage.* There remain to be mentioned, in connection with the bones of the head those of the hyoid and branchial arches. Attached to the hyomandibular is the *stylohyal* from which the other bones of the hyoid arch, called the *epihyal,* the *ceratohyal,* and the *basihyal* are suspended; the last mentioned is formed of two pieces.

To the epihyal and ceratohyal are attached the *branchiostegals*. The basihyal gives support to a bone called the *glossohyal* (which enters the tongue) as well as to a vertical, compressed bone called the *urohyal*. This last is also connected by ligament to the anterior part of the pectoral-arch. A medium chain of bones, few in number, called the *basibranchials*, support on either side the bones of the branchial arch, which are distinguished as the *hypobranchial*, the *ceratobranchial*, the *epibranchial*, and the *upper* and *lower pharyngeal*. The foregoing is characteristic of the teleost cranium and its appendages, but there are manifold modifications.

1. GARPIKES AND THE BOWFIN

With these our account of the true-boned fishes begins. They are known as holosteans (a name derived from the Greek words *holo* whole and *osteon* a bone) and although in some respects primitive in structure, nevertheless in other respects, and not only in the possession of true bone, they are decidedly teleostean (a name derived from the Greek words *teleos* complete and *osteon* a bone); and the bowfin, the only existing member of its kind, heralds the way toward the most generalized teleosts. In many ways the gars and the bowfin are very unlike, and a conception of their specific differences and agreements may be gathered in the description of our Canadian species, which altogether are three in number.

The garpikes are elongated in shape, and the body is covered with uniform hard, enamelled, lozenge-like scales which do not overlap, as cycloid and ctenoid scales do, but articulate together. The jaws compose a sort of beak, beset with teeth, and near the tip of the upper jaw are placed the nostrils. The gars are unique among extant fishes in the form of the vertebrae, each vertebra being convex in front and concave behind, so that the entire column is fitted together in the manner of ball and socket joints. The species, few in number, are indigenous alone to North America, with the exception of one (*Lepidosteus sinensis*) which belongs to China.

The Common Garpike *(Lepidosteus osseus)*

This species shares in common with the other gars the foregoing characteristics. The common garpike may reach a length of about five feet, and is olivaceous in colour being rather silvery beneath, and there are black spots on the hinder part of the body and on the vertical fins. Its air bladder is cellular, constituting a rudimentary lung, and I am confident from first-hand experience that it could live and breathe out of water for at least several days if not longer. A long time ago, when engaged in some fishery matters at the bay of Quinte, I obtained a specimen of this gar and took it along with me to Belleville. The only means of conveying it on the journey was by placing it in a sack. I remarked to the man who drove me that I thought the fish would be alive when we reached our destination. He laughed, but received a surprise at the end of the journey. The fish was placed in a tub of water, not ample enough to permit the extension of its length, but instead of coming to the surface, as a gasping fish would do, it remained at the bottom, and immediately and very rapidly, in a curved state, swam round and round the border of the tub. This remarkable respiratory capability of this fish nevertheless is slight in comparison with the air-breathing function of the lung of the dipnoids, fishes indigenous to Africa, South America, and Australia, for these can live and respire out of water for months at a time; and one of them, the mudfish (*Protopterus annectens*) of Africa, makes for itself at the dry season a capsule of mud, with an opening for the admission of air, in which it resides until the pools are again filled with

water. The common garpike occurs in the St. Lawrence river, and in the provinces of Quebec and Ontario westward to lake Huron; it is very plentiful near Belleville, bay of Quinte; and in the United States it ranges from Vermont westward to the Great Lakes region and southward to the Rio Grande.

The Short-nosed Garpike *(Lepidosteus platostomus)*

This gar is not common in Canada. Its range is the Great Lakes region and the Ohio and Mississippi valleys, besides which it has been reported from Florida and Texas. It attains a length of about three feet. In colour it is rather darker than the preceding, and receives its name on account of its shorter beak.

The Bowfin *(Amia calva)*

This is the only existing species of its kind. It differs greatly from the garpikes in many particulars, yet it is their nearest surviving relative although a very distant relative indeed. Its approach is nearer to generalized teleosts than are any of the fishes we have so far considered, and for the first time we came across a fish occurring in Canada with cycloid scales. Like the garpikes, it also has the air bladder converted into a rudimentary lung, and it can breathe out of water for a longer time than any other North American fish. At the spawning time it leaves the deeper water and generally makes its way into swampy places among aquatic plants and constructs a nest in which its eggs are deposited. The male parent keeps guard over the eggs until they are hatched, and subsequently continues his watchful care over the progeny or fry, which he keeps together by circling around them. The male is smaller than the female, and has a black spot, encircled with yellow or orange, at the front of the caudal fin right at the border of the tail. The former is about a foot and a half and the latter about two feet in length. The dorsal fin is low and very long, and the anal is placed almost midway under the dorsal, and the caudal is rounded. In colour it is ovivaceous or blackish above, paler beneath, and on the sides there is, more or less discernible, a network of dark markings. A pair of very small barbels are placed near the nostrils, and between the rami of the lower jaw there is, horizontally placed, a flat bony jugular plate or shield. Its distribution in Canada is practically much the same as that of the common garpike, and I am under the impression that the two have probably kept a parallel pace, more or less, in their descent and distribution from ancient times. I once saw a specimen lying dead in the water at Madison, Wisconsin, and its distribution in the United States ranges from the Mississippi valley and Great Lakes region to the southern states. The bowfin is often called the dogfish, but it is better to avoid that name to save confusion with the marine dogfishes which, as we have seen, are sharks.

2. CLUPEOIDS

The clupeoids receive their name from the Latin word *clupea,* a herring; therefore all the fishes they embrace are directly related to that important fish. They have close affinities with the salmonoids, but differ in particular from these in lacking an adipose fin. They also bear relationship with the true-boned ganoids (an old term which except for conveniency is falling into disuse) to which the garpikes and the bowfin belong, so that the clupeoids and the salmonoids together belong to the same original primitive stock. The clupeoids, in so far as our members of the group are concerned, for popular purposes may be classified in the following way: (1) clupeoids with no lateral line, and (2) clupeoids with a lateral line.

(1) CLUPEOIDS WITH NO LATERAL LINE

These embrace the herrings and their immediate allies. As the name "herring" with some qualifying word is applied to a number of other clupeoids besides those of the genus *Clupea* and indeed to some other fishes which are not clupeoids at all, the following is a concise diagnosis of the typical genus or true herrings. Some of the specifications, however, are not exclusively peculiar to the herrings but are shared by other clupeoids, yet they are pointed out, for when taken in combination they are characteristic of the true herrings.

The herrings, which are among the most important of commercial fishes, belong to the northern seas where they exist in incalculable numbers and move about in vast schools. The body is elongate, without a lateral line, is covered with loose cycloid or smooth scales, there are serratures or saw-like notchings on the ventral margin of the body, and permanent teeth on the vomer which is a medium bone of the upper jaw.

The Common Herring *(Clupea harengus)*

Ever since George Benkel, a humble Dutch fisherman, who died in 1397, discovered the art of curing the herring this clupeoid has been unsurpassed as a commodity of the sea, and has for centuries afforded one of the chief industries and enterprises of the fisheries. Although a marine fish, according to Boulenger, as first shown by Günther, the fry or 'white-bait' has a predilection for brackish water. It inhabits the temperate and colder parts of the northern Atlantic and seas of Europe, including the British isles, is most abundant on the American side north of cape Cod, and, embracing Newfoundland, extends to the coast of Labrador, occurs in Gaspé bay, has been recorded from the south shore of the river St. Lawrence, and extends in the United States as far south as cape Hatteras, North Carolina. In colour the herring is bluish, being shining silvery below with bright reflections, and may reach a length of about sixteen inches. The serratures are weak, and placed both before and behind the ventral fins. On the New Brunswick side of the bay of Fundy, and at Eastport and adjoining places of the State of Maine, the young of the herring are caught in wicker-work weirs, which are so high as to overtop the water at the inordinately high tide of the bay, and when the tide subsides they are then advantageously fished out. These young are then canned, and under the name of 'sardines' are profitably sold in the market.

The Pacific Herring *(Clupea pallasii)*

It would be well to adopt the above name for the herring of the Pacific waters, although conventionally it has been known as the California herring. This is owing to its occurrence at the coasts of California, which after all is its southern limit, but it is equally as abundant and as widely distributed all over the northern Pacific as its congener the common herring is over the northern Atlantic. It is distributed on both the American and Asiatic sides of the Pacific, and as it ranges from San Diego, California, to Alaska and Kamchatka, it is therefore indigenous to British Columbia and occurs in Puget sound. The Pacific herring, as vernacularly this fish might well be called, had not been in the past turned to the same account industrially as the common herring has for centuries been, yet it exists in great abundance and is now being extensively used. Not having been fished for in the past to any great degree in British Columbia caused it to run to seed, and when in that province I remember being told by a party that whilst on an occasion a vessel was plying along the Pacific coast, B.C., she got in amongst a mass of material which was then unknown to those on board, but on letting down a bucket to procure some of this material it

afterwards was found to be herrings' eggs. The same party further told me that the vessel on the same occasion plied through the egg masses, which existed in millions upon millions for miles and miles without any break in the condition. The Pacific herring is also like the common herring bluish in colour, is silvery on the sides and below; and may reach a length of about a foot and a half. The serratures occur behind the ventral fins only, there being none in front of those fins.

The Pacific Pilchard *(Clupanodon caeruleus)*

This clupeoid is usually known as the California sardine. It is a close relation of the European pilchard *(Clupanodon pilchardus)* the young of which is the sardine of commerce. That term however on the American side of the Atlantic is applied to the young of the herring, but is more appropriately applied to the young of this pilchard in the canning industry of California. It is about a foot in length. In colour it is dark bluish with black spots above and silvery beneath, and the lower part of the back and the tip of the lower jaw are yellowish. It abounds on the coast of British Columbia and Puget sound, and extends southward to Magdalena bay, Lower California, being plentiful on the coast of California.

The Gaspereau *(Pomolobus pseudoharengus)*

The gaspereau, otherwise known as the alewife, inhabits both marine and fresh water. Being anadromous it ascends rivers or streams to spawn, and is sometimes landlocked. It is widely distributed from the coasts of the Maritime Provinces and Labrador, and embraces the St. Lawrence river and lake Ontario, in which lake it is abundant and where great numbers of young ones sometimes die in the summer time. In the United States it extends along the Atlantic coast from Maine southwards to the Carolinas, and also occurs landlocked in certain lakes of the state of New York. It is of a blue colour with silvery sides, is variegated with dark stripes, and behind and near the top of each opercular cover there is a black spot.

The Glut Herring *(Pomolobus aestivalis)*

This fish ranges from the Maritime Provinces to the southern United States, but is more abundant southward than northward. It is very similar to the foregoing, but is longer, darker in colour, the fins are lower, and it has smaller eyes. The chief difference between the two however concerns an internal membrane, the peritoneum, which in the gaspereau is pale whilst in this fish it is black.

The Fall Herring *(Pomolobus mediocris)*

The fall herring is sometimes called the hickory shad. It is mentioned here as it has been recorded from the vicinity of Campobello island, New Brunswick, by Doctor Phillip Cox of Fredericton University. Ordinarily it ranges from cape Cod to the coast of Florida. This species is described by Doctors Jordan and Evermann as being bluish silvery in colour with rather faint longitudinal stripes on the sides, that it is not highly valued as a food fish, and that it does not ascend streams to spawn.

The Blue Herring *(Pomolobus chrysochloris)*

The blue herring or skipjack is a fresh water fish, although in its southern range it enters the Gulf of Mexico. Its range otherwise is the Great Lakes (at least Lakes Erie and Michigan, into which it has introduced itself through the canals), the Ohio river, and the Mississippi valley. It has therefore little to do

with the fishes of Canada, but will probably continue to distribute itself over the Great Lakes. It is reputed to be about fifteen inches in length, of a beautiful blue colour with silvery sides and golden reflections.

The American Shad *(Alosa sapidissima)*

Formerly the range of this shad was much more extensive than it is now. The following quoted from my check list concerns what its condition was in the year 1913, and I am not aware of any marked change in its condition since then. It "extends, or did extend, from Labrador, Newfoundland, gulf of St. Lawrence, and Maritime Provinces to the gulf of Mexico, but its distribution in our waters more limited and local than formerly: 'occasional in baie des Chaleurs' (Cox, 1895): still frequents the shores of St. John and Albert counties, and ascends the St. John river, New Brunswick; as well as occurring in Chignecto, Cobequid and St. Marys bays, and bay Verte, Maritime Provinces: mentioned as occurring in Gaspé bay (Stafford, 1905-1906, as *Clupea sapidissima*): 'formerly abundant in the lower Ottawa, but has abandoned that river, and its occurrence within our boundaries [Ontario] is now only accidental' (Nash, 1908): has been introduced into Pacific coast waters by the United States Fish Commission, and has 'been established in several of the tributaries of the Mississippi river, [and] notably the Ohio river' (Goode, 1888)". The American shad may attain a length of about two and a half feet. It is bluish in colour the sides being silvery, behind and at the top of the opercular cover there is a dark spot and often a number of other spots along the sides.

The Menhaden *(Brevoortia typrannus)*

The menhaden, sometimes called the mossbunker, is one of the most erratic in its movements of migratory fishes. It is used as a fertilizer, and a number of years ago on visiting a firm in New York, engaged in a menhaden fertilizing industry, I was informed that one great obstacle in the business was owing to how little that fish could be depended upon in turning up at places where it had been plentiful in one season and not there at all in another. It is toothless and largely herbivorous, but it also feeds extensively, as ascertained by Rathbun, on minute crustaceans and other minute marine organisms. These would require to be in millions to meet the needs of a school, and I have an impression that possibly as such might be subject to be wafted about by storms or currents, its movements may be regulated by where at particular times it can obtain a plentiful supply of food. Degrees of temperature also have doubtless to do with change in its movements. The deceased Brown Goode gave its approximate wanderings for the year 1877 as follows: "Bounded by the parallels of north latitude 25° and 45°; on the continental side by the line of brackish water; on the east by the inner boundary of the Gulf Stream." The menhaden reaches a length of about a foot and a half. Its colour above is bluish, its sides are silvery with a bronzy lustre, it has a dark spot high up behind the opercular covering behind which on the fore part of the body there are usually smaller spots, and its fins as a rule are yellowish.

The Gizzard Shad *(Dorosoma cepedianum)*

This clupeoid differs from the foregoing species by the stomach being modified into a muscular gizzard-like organ; hence its name. It, like the fall herring, is also sometimes called the hickory shad. It has a wide distribution, and virtually occurs all over the eastern portion of North America from the Atlantic coast to the Mississippi slope, and inhabits all sorts of aquatic environments; living in the sea, in brackish water, in rivers and in lakes, and is sometimes land-

locked. It has been recorded from the St. John river at Fredericton, New Brunswick, presumably occurs in the St. Lawrence system, ranges along the Atlantic coast at least from cape Cod to Mexico and extends westwards in the United States to the Mississippi river, and has besides been introduced into lakes Erie and Michigan. The ventral surface of the gizzard shad presents a fine edge, and is protected throughout its length by bony serratures. The last ray of the dorsal fin is much elongated and filamentous or thread like. It is toothless. It is about fifteen inches in length. In colour it is bluish above and in general silvery, and the edge of the anal fin and the tips of the ventrals are often dusky.

The California Anchovy *(Engraulis mordax)*

This is the only anchovy indigenous to the waters of Canada, but as it has relatives of other genera, yet of the same family, indigenous to the Pacific it is expedient to retain the name, the California anchovy, by which it is conventionally known. It ranges from the coast of southern Alaska to the coast of Lower California, Mexico, and therefore occurs on British Columbian coasts. It is closely related to the European anchovy (*Engraulis encrasicholus*). It may reach a length of about seven inches. In colour it is bluish above and silvery beneath. Its jaws are beset with small teeth. A peculiarity is its projecting snout, which precedes the inferiorly positioned mouth, and which has been likened to that of a pig.

(2) CLUPEOIDS WITH A LATERAL LINE

These, in so far as our species are concerned, embrace the mooneyes and, owing to its having casually turned up in Nova Scotian waters, the tarpon.

The mooneyes are well compressed clupeoids. There are probably four species of them, although they have usually been placed as three, and if there are four, then three are indigenous to Canada. All are confined to North America east of the Rockies. Various parts of the head and jaws are well toothed. They are all silvery in colour and attain a length of about a foot. One of the species (*Hyodon selenops*) confined to southern States of the Union, is said to be not so compressed as the others and to be of greater proportionate length.

The Mooneye or Toothed Herring *(Hyodon tergisus)*

This is the representative species and has the widest distributional range. It is one of the most beautiful of our fishes: shining silvery with an olive shade above. It is about a foot in length. Its range embraces the St. Lawrence and Ottawa rivers, and according to Montpetit, 1897, lake St. Peter; the Great Lakes region including Lake of the Woods; and the Ohio and Mississippi valleys.

The Shad Mooneye *(Hyodon alosoides)*

This species inhabits rivers and lakes of Manitoba and presumably of Saskatchewan, and it also occurs in the Ohio river region. It is bluish in colour being silvery on the sides with golden reflections; and closely related to it, but likely specifically distinct, is the western goldeye (*Hyodon chrysopsis*) of rivers and lakes of Manitoba and Saskatchewan.

The Tarpon *(Tarpon atlanticus)*

This is a large fish of about six feet in length; the ordinary range of which is from Long island to Brazil, but as it has been casually recorded from Nova Scotia it is entitled to admission among the fishes of Canada. The specimen was found at Harrigan cove, near Isaac's harbour, in eel-grass, and is preserved

in the Provincial museum at Halifax. By rights the tarpon is a fish of more southern waters, and is common on the coast of Florida and coasts of the West Indies. According to Evermann and Marsh it is "common about Porto Rico where it evidently breeds, as numerous immature individuals were taken at Hucares and Fajardo". The tarpon is covered with strong cycloid silvery scales which are unusually large, often several inches across, and which are turned to ornamental account. Like the bowfin it has a horizontal bony plate between the rami of the lower jaw; like the gizzard shad it has the last ray of the dorsal fin very long and filamentous; and its pectoral fins are placed very low down, so that like the ventrals, they can be folded together. The tarpon excites the interest of the angler, and as it readily takes the baited hook, and in its habits leaps with vigour out of the water, it affords to those who angle for it the utmost sport.

3. SALMONOIDS

The salmonoids as a group, there being a few exceptions, are fishes of the temperate and arctic zones of the northern hemisphere. Some of them spend a great part of their time in the sea, but enter and ascend rivers or brooks for the purpose of spawning. Others live in lakes, but also enter rivers, or come to the shallows to spawn; whilst others again spend much, if not all, of their time in sparkling streams. Their eggs are relatively large, are discharged into the cavity of the abdomen before being finally extruded, are non-glutinous and non-adhesive, and these facts constitute their eggs admirably adapted for being hatched through artificial methods.

They are, as geological time is reckoned, of recent origin, none being known through fossil remains earlier than the Miocene period, yet although generally alert and active, possessing great muscular power, they manifest certain primative features, such as among other things, the abdominal position of the ventral fins, the absence of spines in the fins, the possession of what is called a meso-corocoid arch which has to do with the skeleton of the head, and the retention throughout life of a duct communicating between the air-bladder and the digestive tract.

It is probably owing to their comparatively recent origin that there is often confusion as to the determination of valid species among the salmonoids, and frequently, no doubt, for that reason species have been unduly multiplied. Many of them may be species in the making, not having had sufficient time to differentiate so as to warrant their recognition as separate species.

All the salmonoids have an adipose fin, which is simply a fatty protuberance placed between the dorsal and caudal fins; and the scales are cycloid or smooth instead of being, as in the majority of higher fishes, ctenoid or combed. A lateral line, with perforated scales, may run continuously over the entire length of the fish from the head to the caudal fin, or may be interrupted as in the smelt.

The salmonoid fishes of Canada may conveniently be classified as follows:—

(1) Whitefishes and Ciscoes.
(2) The Inconnu.
(3) Salmonoids of the Pacific genus Oncorhynchus.
(4) Salmonoids of the typical genus Salmo.
(5) The Salmon Trout and its congener the Siscowet.
(6) Charrs in General.
(7) The Arctic Grayling.
(8) Smelts and the Capelin and the Oolachan or Candlefish.

(1) WHITEFISHES AND CISCOES

These may easily be considered together. One distinguishing feature is, that in the former the upper jaw projects beyond the lower, whilst in the latter the opposite is the case—the lower jaw projects beyond the upper. They seem to be rather involved in distinction of species, but a good number of well determined species are indigenous to Canada. These fishes are not restricted to North America for there are species peculiar to Europe and also to Asia.

The Common Whitefish *(Coregonus clupeiformis)*

This is the most valuable of our strictly speaking fresh water fishes. It is abundant in the Great Lakes, and very abundant in lake Erie where it has often been stripped of its eggs, which have been fertilized on the spot and subsequently transported to the incubators of the hatcheries. Its distribution has been reputed to be from Labrador and New Brunswick to the Prairie Provinces and northward, but some United States ichthyologists have contended that all references to its occurrence west of lake Superior need verification. The common whitefish is the largest of all our whitefishes, and may reach a length of two feet, but the average length is far below that. In colour it is olivaceous above and white beneath, and its lower fins may be dusky. The dorsal fin is high, the ventral fins are placed below the posterior portion of that fin, and the caudal fin is deeply forked. No other fresh water fish can excel it as an article of food, and it affords the principal fresh water fish industry. Its food consists of minute crustaceans, mollusks and aquatic insects, and such may be considered as essentially the nature of the food of the whitefishes in general.

The humpback whitefish (*Coregonus nelsonii*) is closely related to the common whitefish, but is elevated and compressed on the back, and is plain in colour. It occurs in Alaska, but has been recorded, 1907, by Doctors Evermann and Goldsborough from lake Bennett, British Columbia.

The Sault Whitefish *(Coregonus labradoricus)*

This, otherwise known as the Labrador whitefish, is a widely distributed species. It ranges from Labrador and the provinces of Quebec and New Brunswick to the Prairie Provinces, and embraces the Great Lakes region including the lake of the Woods, and is abundant at Sault Ste. Marie. In the United States, according to Doctors Jordan and Evermann, it occurs from the "Great Lakes region to the lakes of the Adirondacks and White mountains, and northeastward." In colour it is bluish-black above and silvery below, there are marks on the edges of the scales, and the fins are dusky. It is rather slender in form, and a readily distinguishing feature is a series of permanent small teeth on the tongue. It delights in cool and clear waters, whether in rivers or in lakes, and attains a length of rather over twenty inches.

The Rocky Mountain Whitefish *(Coregonus williamsoni)*

This beautiful little whitefish, which is only about a foot in length, frequents clear streams and lakes, ranging from Alberta and Montana to the coasts of British Columbia and the states of Washington and Oregon, and extends southward apparently as far as Utah and Colorado. I have seen it in the clear waters of the Bow river in the vicinity of Calgary, Alberta. It is of a bluish colour with silvery sides, and marked on the tips of all the fins with black; and it can vie with any other whitefish in beauty and alertness.

Another small species, Coulter's Whitefish (*Coregonus coulterii*), is closely related to the rocky mountain whitefish, but it is only eight inches in length, and its scales are relatively larger. Its range, in so far as I know, has only as yet been recorded from the Kicking Horse river at Field and Golden, British Columbia.

The Round Whitefish or Shad-Waiter *(Coregonus quadrilateralis)*

This is the most widely distributed of all our whitefishes. According to its records it extends from Labrador, New Brunswick, and the New England states, occurring in the Great Lakes region, to British Columbia, Alaska, and the Arctic regions. It is mostly a lake fish, as it seldom enters rivers, and it does not much exceed a foot in length. In colour it is dark bluish above and silvery below.

Mention is here made of the broad whitefish *(C. Kennicotti)* and of Richardson's whitefish *(C. richardsonii)* concerning which little is known. The former occurs in the Mackenzie and Yukon rivers and in certain rivers of Alaska; but it has also been recorded, 1907, by Doctors Evermann and Goldsborough from Great Bear Lake in the far north and from lake Bennett, British Columbia. The latter is a doubtful species, and may be a variety of the former or indistinguishable from it. Its type was from Arctic North America (Günther, 1866) somewhere in the Canadian possessions, but the locality otherwise not known, and the only other available record is that of Preble, 1903-4, from the Mackenzie River basin.

The Cisco or Lake Herring *(Argyrosomus artedi)*

This fresh-water fish is of much commercial value. It ranges from the province of Quebec and the state of Vermont, occurring in lakes Champlain and Memphremagog, and in Thirty-one-mile lake some sixty miles north of Ottawa, and extends westward to lake Superior. It is abundant in lake Erie, where it has often been stripped of its eggs for hatchery purposes. It extends northward to the Hudson bay region and to Labrador. It is as often called the lake herring as the cisco, which is a misnomer, for no true herring has an adipose fin; but it doubtless received that name on account of a supposed resemblance to the herring. It reaches a length of about a foot, and it and its immediate congeners, as a rule, display greater activity than the whitefishes in general do. In colour it is greenish or bluish-black above, and silvery underneath, with dark coloured specks on the sides whilst the upper fins are pale and the under dusky.

The Great-Bear-Lake-Herring *(Argyrosomus lucidus)*

This is a cisco of the far north, being known to inhabit the Mackenzie river and its tributaries; and has been recorded by Richardson, 1836, from Great Bear lake; by Gilbert, 1894, from Great Bear Lake river; by Scofield, 1899, from Herschel Island; and by Preble, 1903-4, from the Arctic Red river. It is said to be silvery in colour, and from specimens described may be about sixteen inches in length.

The Longjaw or Bloater *(Argyrosomus prognathus)*

This cisco, which receives its name of Longjaw from the length of the mandible or lower jaw, inhabits the basins of the Great Lakes with the probable exception of lake Erie. It reaches a length of about fifteen inches, and is coloured dark above, silvery on the sides and white below, whilst the fins in general are pinkish, and in addition the dorsal and caudal fins are edged with dusky. It is a deep-lake fish, which may account for its apparent absence from the shallow waters of lake Erie.

The Tullibee *(Argyrosomus tullibee)*

The body of the tullibee is deep. It occurs in the Great Lakes, in lake of the Woods, in lake Onondaga in the state of New York, in the provinces of Manitoba and Saskatchewan: frequenting the Qu'Appelle lakes near the middle

of the chain, where I have seen it, and was recorded by Richardson, 1836, from Pine Island lake and from the Albany river region. It is a beautiful fish of a bluish colour above with fine dots on the sides, and the fins are tipped with black. It is about a foot and a half in length.

The following from the pen of Mr. F. C. Gilchrist, at one time Inspector of Fisheries at Fort Qu'Appelle, concerning the tullibee, is of interest:—

"They prefer shallow water close to the shore with clean sand to spawn on, and during the day they may be seen in pairs and small schools, poking along the shores, but at night they come in thousands and keep up a constant loud splashing and fluttering, very strange and weird on a calm night."

The name tullibee is sometimes applied, but erroneously, to other kinds of fish in different parts of the Dominion.

(2) THE INCONNU (*Stenodus mackenzii*)

This is a fish of the northern regions of the Pacific side of North America. It occurs in the Mackenzie and the Yukon rivers and their tributary waters; and was also recorded by Richardson, but long ago, from Salt river, 1823 (the type), and Great Slave lake, 1836. It is silvery in colour, and attains a large size. Its dorsal fin is high, the ventral fins are placed immediately below that fin, the caudal fin is forked, it has feeble teeth, and the eyes are small. It stands intermediate between the whitefishes and ciscoes and the salmon and trout, but comparatively few have seen it, therefore little as yet is accurately known concerning it. A report on the distribution and economic importance of the inconnu in the Mackenzie River valley, based on first hand observations, by Mr. J. C. D. Melville, at the time a member of the Canadian Fisheries Advisory Board, is contained in the Fisheries Annual Report for the fiscal year 1913-14. An inconnu *(Stenodus leucichthys)* indigenous to Siberia is perhaps by rights identical with this species.

(3) SALMONOIDS OF THE PACIFIC GENUS ONCORHYNCHUS

The group of salmon as designated above, belong to a genus which differs from the typical genus of all the salmonoids, *Salmo,* in a number of points either structural or physiological. There are however some species of *Salmo,* indigenous to the Pacific side of our continent as well as to the Atlantic side. The genus now under consideration is known as *Oncorhynchus.* All the species in this genus agree in having a longer anal fin with more rays than is the case in those of *Salmo,* and in spawning only once. These fishes become dilapidated and impoverished at the spawning season. In fact they become perfect wrecks as it were. The sides become raw, and more or less denuded of scales, the rays of the fins broken, and the teeth of the males become abnormally large and they develop humps upon the back in front of the dorsal fin. (But see under the description of the spring salmon.) On the other hand, their eggs are like beautiful gems, and it is just as if these fishes had thrown all their own vitality into their eggs on behalf of their posterity, and very soon after the eggs have been extruded and fertilized the parent fishes die. All the Pacific salmon (as here understood) undergo remarkable seasonal changes, applicable to either sex, but especially to the males, from the time they leave the sea until they reach their spawning beds.

The Sockeye Salmon *(Oncorhynchus nerka)*

The Sockeye is here treated of first, because it has been commercially the most important of the Pacific coast salmon. It has been preferred for canning purposes, and its flesh when boiled is of a deep red colour and is suffused with a

rich amber coloured oil. On the other hand it is said to have a less rich flavour than the spring salmon. The sockeye attains a length of about two feet. In colour it is blue on the back with a silvery sheen, and silvery on the sides, whilst the upper fins are dusky and the lower pale. At the spawning time it becomes red on the back and sides, and whitish underneath. It ascends all the important rivers of British Columbia, and spawns in streams which are connected with lakes. I myself have been at its spawning beds beyond Harrison Hot Springs, B.C., and it was there I was struck with the resemblance of its eggs to beautiful gems. It occurs on both sides of the Pacific, ranging on the American side from Oregon to Alaska, and on the Asiatic side southward to Japan, being also landlocked in lake Akan in northern Hokkaido. In certain lakes and rivers of British Columbia, and of the states of Idaho, Washington, and Oregon, there is a fish known as the little redfish or Kennerly's salmon *(Oncorhynchus kennerlyi)* which is closely related to the sockeye, and which may bear much the same relationship to the sockeye as the ouananiche and landlocked salmon bear to the Atlantic salmon. The little redfish is said to be sexually mature when it has attained a length of one foot or even less.

The Spring Salmon *(Oncorhynchus tschawytscha)*

The spring salmon, long known as the quinnat, is the largest of the Pacific coast salmon, and the earliest usually to ascend the rivers. It may reach a length of about five feet. It spawns in streams of considerable size, ascending to their head waters, travelling in many instances several hundred miles, and surmounting numerous heavy rapids and falls on the way. It frequents both coasts of the Pacific, and ranges from the coast of California around to the Behring sea and hence to Kamchatka and China, but it does not frequent Japan, probably because there are no rivers of great size there. The spring salmon is of a dusky colour on the back which may be variegated with olivaceous, the head being darker, and is silvery on the sides and beneath; and the back of the fish and the dorsal and caudal fins are marked with black spots. Toward the spawning time the males become blackish in colour mingled with red. Its flesh may be either red or white, but in either instance there is no external difference in the appearance of the fish. Mr. Alex Finlayson, the Federal Superintendent [Has just been appointed to this position] of Hatcheries, tells me he has seen spring salmon and pink salmon on spawning beds of the sockeye, and that whilst the pink and sockeye were ragged and worn, the spring salmon presented a clear and fresh appearance without any marks of distortion. This may offer a question that the spring salmon may be longer lived than is commonly supposed, or even that individuals may sometimes return to the sea.

The Coho or Silver Salmon *(Oncorhynchus kisutch)*

The Coho bears an outward resemblance to the sockeye from which it is readily distinguishable on account of its scales, which are thin, easily falling off excepting those on the lateral line. In colour it is bluish green on the back, and silvery on the sides which are covered with dark marks. The pectoral fins are dusky, and the dorsal and adipose fins and the top of the caudal fin, as well as the back and the top of the head, are sparingly spotted. It is about fifteen inches in length. The coho enters the shorter streams, therefore its spawning resorts, comparatively speaking, are not of very great distance from the sea. It ranges on the American side of the Pacific from the coast of California to Alaska, and on the Asiatic side southward to Japan. Its flesh which is rather a pale red in colour is of excellent quality, and is used for the fresh fish markets and for canning.

The Chum or Qualla Salmon *(Oncorhynchus keta)*

The flesh of the chum salmon is also excellent when fresh, and can readily be salted—a condition in which it is largely used in Japan. This species ranges from California to the Behring straits, Kamchatka, and Japan; and on the authority of Doctor David Starr Jordan is "by far the most abundant species of salmon" in Japan. In colour it is dusky on the upper parts and paler on the sides, and may either be marked or unmarked with black dots, and as a rule the fins are blackish. As the spawning time approaches the males become red and are often mottled or barred. Like the coho the chum spawns in the shorter or smaller streams.

The Pink Salmon *(Oncorhynchus gorbuscha)*

This is the smallest species of the genus. It ranges from California to Kamchatka, and ascends many of the larger streams as well as the smaller ones. In colour its upper parts are bluish and the under silvery, and it is variegated on the upper and hinder parts with numerous black spots, whilst the caudal fin is beset with a number of larger oblong black spots. Its flesh is a rich pink, and although not as firm as that of the sockeye is of excellent quality and flavour. Formerly this salmon was known as the humpback owing to the humped condition which the males assume at the spawning time, and towards that season the distorted males become a dirty red in colour.

(4) SALMONOIDS OF THE TYPICAL GENUS SALMO

Taken as a group the fishes which come under this genus, which is the typical genus of all the salmonoids, are very widely distributed and occur in seas, lakes, rivers, and streams of Europe, Asia and North America. A readily distinguishing feature from the Pacific genus *Oncorhynchus* is the shorter anal fin with fewer rays; nor do they spawn once for all and die, but spawn year after year, and those kinds (at least in general) that inhabit the sea, annually resort back again to their own particular rivers for that purpose. Nevertheless, Doctor Knut Dahl who has made investigations into "The Age and Growth of Salmon in Norway" has reached the conclusion that the Atlantic salmon is not long lived, that many die as an effect of spawning, and apparently that only an infinitesimal number return to spawn a third time.

The Atlantic Salmon *(Salmo salar)*

Not only is the salmon of the Atlantic the treasure of the sportsman, but it is of great importance as a commercial commodity on account of the well known rich and delicious flavour of its flesh. Allusions to the salmon in literature, ever since the days of Pliny until now, are numberless; and the books which have been written upon it, either as to its natural history or as an object of sport, voluminous.

The salmon has distributed itself very widely over both coasts of the Atlantic and its affluents. It occurs in the seas and rivers of Europe, including Iceland, enters the Baltic, and its southern limit of distribution in Europe is said to be Galicia, Spain. On the American side it occurs in the St. Lawrence river and gulf with their tributary waters; in the Northumberland straits, the bay of Fundy, and other parts of the Maritime Provinces; Newfoundland; Labrador; and northeastern states of North America, presumably to the Delaware river; and has also been recorded by Fabricius, 1780, in lakes and rivers of Greenland, and by Pennant, 1788, from Hudson bay. After the hatching out of the fry, the parrs, which are striped, remain in the rivers; the smolts return to the sea;

the grilse re-enter the rivers, and are capable of spawning; and the mature fish adhere to their own rivers in their annual spawning, returning to the sea in the spring of the year. In colour the mature salmon is brownish or steel-blue on the back and silvery on the sides, and the body, head, and fins are more or less covered with black spots, whilst upon the sides of the males there are red patches. The ventral fins and the anal fin are whitish, the former on the inner sides being grayish, and all the other fins are dusky. Ordinarily the salmon may attain a weight of fifteen pounds, but very much heavier ones are on record.

A generation or so ago a variety of the Atlantic salmon inhabited lake Ontario, and as recently as 1905 a specimen of this variety was found near South bay, Manitoulin island, lake Huron. Two other varieties, more or less land-locked, occur in lakes and rivers of the Atlantic slope. One of these is the ouananiche (*Salmo salar ouananiche*) which is found in the Saguenay river and the lake St. John regions, and in lakes and rivers northward to the Ungava region and eastward to Labrador, and it also occurs in certain lakes of Newfoundland. The other is the sebago or land-locked salmon (*Salmo salar sebago*) which chiefly seems to differ from the ouananiche in being larger. The natural distribution of the sebago is certain lakes of New Brunswick and the states of Maine and New Hampshire, but it has now a wider distribution through having, in the United States, been introduced into lakes of other localities. Barring smaller size, and non-migratory habits, these two varieties, which have been recognized as sub-species, appear to differ little from the regular Atlantic salmon.

The Steelhead Salmon *(Salmo rivularis)*

The steelhead is interesting as an instance of the occurrence of salmonoids of the genus *Salmo* in Pacific coast waters. It spends much of its life in the sea, but like its relative the Atlantic salmon annually ascends rivers in order to spawn. It is not a fish favourable for canning purposes owing to the firmness of its bones, otherwise its flesh is excellent food. It is distributed from British Columbia to California and eastward to the mountains, and extends as far north as Skagway, Alaska. The United States Fish Commission introduced it into lake Superior, and it has since been found in waters of Ontario. In colour it is greenish above and silvery below, and the head, the back, and the dorsal, adipose, and caudal fins, are covered with black spots; and at certain seasons of the year, there are flesh-coloured bands along the sides, and the opercular covers then assume a rose colour. This fine salmon attains a length of about two and a half feet.

The Kamloops Trout (*Salmo rivularis kamloops*) which is indigenous to Kamloops, Kootenay, Okanagan, and other lakes in British Columbia, including certain lakes tributary to the Fraser and upper Columbia rivers, is a variety of the steelhead.

The Rainbow Trout *(Salmo irideus)*

A recent contention on the part of some is that the rainbow trout is simply an earlier stage, in the course of its life history, of the steelhead. Provisionally considered as in itself a valid species, it is a choice salmonoid of the Pacific slopes of North America, and ranges, under a number of varieties, from British Columbia to California. In colour it is bluish above, silvery on the sides, and plain below, being spotted on the back, on the sides, and on the vertical fins, and there are red lateral bands, extending, one on either side, over the entire body of the fish. It has been introduced, under the auspices of the United States, into lake Superior. According to the Report of the Game and Inland Fisheries Board of Newfoundland for the year 1910: "The California Rainbow Trout has proved its great adaptability to the environment of Newfoundland waters". It has also been introduced into glacial fed lakes in New Zealand.

For its introduction into Canadian waters at places where previously it did not belong, see "Introductions of Non-indigenous Salmonoids" by Mr. J. A. Rodd, Director of Fish Culture for the Dominion, appended to the account of our salmonoids, and which was prepared by him for this work.

The Cutthroat Trout *(Salmo clarkii)*

This fish receives its name from a deep red blotch on the membrane connecting the bones of the lower jaw. It has a considerable distribution, subject to great variation, being found in southern Alberta and in British Columbia, and ranges from northern California perhaps as far north as Alaska. The above however does not embrace the entire distribution of all the varieties of the cutthroat, and my endeavour is to limit, if possible, the range to that of our own form. As a matter of fact the numerous varieties of the cutthroat may often so resemble each other, or perhaps intergrade, that it appears well nigh impossible to definitely mark them off from one another. Quite probably the species originated in Asia, where the original form, perhaps more or less modified, may be that still existing in Kamchatka. But any attempt to treat of such an intricate subject here would involve a digression altogether out of keeping with the object of our account, and might not be of interest to the general reader. In any case, the possession of the red blotch in all the varieties seems to be generally constant. The cutthroat delights in cold streams or seething rapids, and has a predilection for entering the sea. It is silvery in colour, usually the back and tail part (the caudal peduncle) being covered with black spots, and the dorsal, adipose, and caudal fins are also spotted, whilst the paired fins and the anal fin are unspotted and may be reddish or yellowish, but it varies in coloration. Distinctive specific features are these: the scales are very small and therefore numerous, and there are usually small teeth at the base of the tongue.

The Brown Trout *(Salmo Fario)*

This is an imported European species. It was in the first place introduced into the United States, and from there its eggs, along with those of the Loch Leven trout, were incubated in our hatcheries, and the fry planted in Canadian waters. (But see the appended account of the introduction of non-indigenous salmonoids already referred to.) In its native haunts the brown trout occurs in lakes and rivers all over the British Isles and in northern Europe. Its ground colour, although in tint it varies, is generally yellowish brown, and it is covered with numerous dark spots, the lower parts of the sides are of golden hue, and the under part of the fish is a silvery white. The fins are light brownish, and there are spots on the dorsal, adipose, and caudal fins. The Loch Leven trout *(Salmo fario levenensis)* is now known to be purely a variety of the brown trout which centuries ago was introduced into that lake. In this new environment, and probably under care and attention bestowed on it, it became modified, so that, as a variety, it is regarded to be separable from its original ancestor. It now occurs in Loch Leven, Fifeshire, and certain other Scottish lochs and in lochs in the north of England. Also it has been introduced in recent times into waters of Newfoundland.

(5) THE SALMON TROUT AND ITS CONGENER THE SISCOWET

These charrs have been separated from the charrs in general and placed in a genus by themselves, chiefly owing to the crested and strongly toothed vomer.

The Salmon Trout or Great Lake Trout *(Cristivomer namaycush)*

The salmon trout is commercially one of the most important of our freshwater fishes, and has been extensively propagated artificially. It has a wide distribution, extending from Labrador, the Maritime Provinces, and the state of

Maine, to Vancouver island, Alaska, the Mackenzie river, and the Arctics. It is very common in the Great Lakes region and in smaller lakes in Ontario, and thrives under the protective restrictions of the Algonquin National Park. It is subject to great variation, and there may be considerable reason for the distinctive popular names which have been bestowed upon its several varieties. Such distinctions in form and colour however are not really fundamental differences in structure, and with the exception of the siscowet which has been assigned sub-specific rank, all the varieties are regarded by ichthyologists to belong to one and the same species. The salmon trout is very voracious, and preys largely upon other fishes; and it likes deep water, but comes to the shallows to spawn. In colour it is gray with paler spots and the dorsal and caudal fins are marked with reticulations of a darker hue. It is the giant among the charrs, and may reach a length of about three feet.

The siscowet *(Cristivomer namaycush siscowet)* is very closely related to the regular form of the salmon trout, but the bones of the head are shorter and broader, and it is very fat. It belongs to lake Superior, but is said to be occasional also in lakes Huron and Erie.

(6) CHARRS IN GENERAL

The charrs in general are embraced in the genus *Salvelinus* which agrees with *Cristivomer* in having the vomer boat shaped, whereas in *Salmo* the shape of the vomer is flat. They differ however from the salmon trout, as already pointed out, in lacking the strong toothed vomer.

The Speckled or Brook Trout *(Salvelinus fontinalis)*

This charr is essentially a fish of the eastern half of the North American continent. It extends, presumably, from the Arctics to the states of Georgia and Alabama from north to south, and from Newfoundland to Saskatchewan from east to west. It is an angler's favourite, and delights in clear waters in the eastern portion of Canada. I have seen very small specimens in a sparkling stream, where the water was only a few inches deep, in the Gatineau district; and I saw it in plenty in a brook, the outlet of a good sized lake, at Baie Ellis, Anticosti island. It is a handsome fish, dark in colour and mottled on the back with olive, and with red spots on the sides, and the dorsal and caudal fins are mottled, whilst the lower fins are preceded by an orange margin; but it varies greatly in coloration and in size, according to the nature of the streams or waters it frequents. Nipigon lake, Ontario, is noted for its large sized individuals, and there is a large sun-run variety known as the sea-trout *(Salvelinus fontinalis immaculatus)* which generally lacks the bright red spots usual in other varieties. The speckled trout may reach a length of about a foot and a half. Besides the transplanting of its fry by the Fish Cultural Branch of the Federal Fisheries, it has been introduced with success into waters of the Banff National Park by the Canadian Pacific Railway Company; into southern British Columbia, including Vancouver island, by private enterprise; and in the United States into streams west of the Mississippi. It has also been successfully introduced into streams of England and the continent of Europe.

The Dolly Varden Trout *(Salvelinus parkei)*

This is another beautiful charr. It is olivaceous in colour, and there are red spots not only on the sides, as in the speckled trout, but also on the back; a feature not shared by any other species of the genus, at least in our waters. The red spots are large, and the lower fins are dusky, preceded by a pale coloured margin followed by a darker one. Sea-run individuals are silvery in

colour, and the spots faint or awanting. Its distribution ranges from California, embracing British Columbia, northward to the Aleutian islands; and has been recorded by Scofield, 1899, from Herschel island, Beaufort sea, Arctic ocean. It may attain a length of two feet or more.

The Red Canadian Trout *(Salvelinus marstoni)*

As yet this beautiful little salmonoid seems only to have been found in certain lakes of the province of Quebec, and has been recorded from lac de Marbre near Ottawa; from lakes of the Laurentides Club in the lake St. John region; from lac a Cassette, Rimouski county; from lake Saccacomi and the Red lakes, Maskinonge county; and has been caught by Mr. Alex. Finlayson, Federal Superintendent of Fish Hatcheries, at the chain of Three Lakes near the Bark River hatchery, twenty-eight miles from St. Paulin. A specimen of a charr which was caught probably over forty years ago in the township of Decalonnes about forty miles north of Montreal, and formerly referred to the Greenland charr, was in all probability a specimen of the red Canadian trout. Later, the same specimen was referred to as a variety of *Salvelinus oquassa,* but it is now evident that this charr of our waters is entitled to full specific rank. I have an impression that the centre of the distribution of this trout is much further north than hitherto recorded, and that as yet it is known only at the southern limits of its range or thereby, that limit happening to be where the localities are already settled. Fortunately, however, not only are some of its resorts now well known, but its specific distinctions are determined to be well marked, so that it need no longer be mistaken for a variety of any other charr. It is of brilliant and varied coloration. The head is black on the top, silvery on the cheeks and white below; the back is brown with bluish iridescense shading into whitish; and the sides are pinkish. The dorsal fin is dark; the pectoral and ventral fins and the anal fin whitish or yellowish at their bases and margins, and orange in the centre: and the caudal fin is brown, edged with paler, and yellowish at the base. The general ground colour of the fish is a uniform vivid red, and it may reach a length of about a foot.

The following concerns a number of alleged charrs indigenous to the arctic regions, but there is confusion in their records and synonyms, leaving it hard to determine them distinctively as species. Provisionally, but as sub-species, I admitted four into my check-list, viz.: the long-finned charr, the Greenland charr, the Arctic charr, and Nares charr. Many of their records ante-date far back, a record of the long-finned charr, that of Fabricius, antedating as far back as 1780. The three first mentioned are regarded to be varieties of the European charr (*Salvelinus alpinus*) and the fourth is regarded to be a variety of the Oquassa trout (*Salvelinus oquassa*) of the Rangeley lakes of the state of Maine. Considered jointly such charrs have been recorded from rivers or lakes of Regent's inlet, Boothia Felix, Coppermine river, Cumberland gulf, Discovery bay, Greenland, and other Arctic parts; and the Greenland charr has besides been recorded from Labrador.

A work has recently been published by the King's Printer, 1928, entitled "A Faunal Investigation of Southern Baffin Island", the author of which is Mr. J. Dewey Soper. This work presents a lucid account of "the known essential facts concerning the fauna of Baffin island". It contains notes on the specimens of fishes he collected, with information supplied by me, and the following quotation regards the charrs contained in the collection:—

"As regards the Arctic charr, of which there are a number of specimens in the collection, probably when all the reputed varieties are better known, it may be found that all are referable to one and the same species, viz: *Salvelinus alpinus.* Nevertheless, if such be the case, it has been recorded under a number of trinomial distinctions, such as:—

Salvelinus alpinus alipes Richardson.
" " *stagnalis* Fabricius.
" " *arcturus* Günther.

"I regard these to be, at most, only local variations, indigenous to the cold Arctic waters, of the typical European *Salvelinus alpinus,* and have therefore, provisionally placed them binominally in the list. There is much confusion in the reports of these alleged varieties, some of the records of which are very old or very locally reported. Another alleged species or sub-species, recorded presumably only from Discovery bay and Cumberland gulf, is *Salvelinus oquassa naresi* Günther, which may not be separable from the typical *S. oquassa,* which itself, in so far as I know, has only been recorded from Rangeley lake in the state of Maine, and it may even be questionable whether or not *S. alpinus* and *S. oquassa* are themselves separable as species.

"It is quite feasible to suppose that fishes with a more or less circumpolar distribution might extend as varieties to the temperate zone either of Europe or America, so that there may be no real justification in separating them as distinct species, and *S. alpinus* and *S. oquassa* may be a case in point; but until, for comparison, there is access to a large and well preserved number of specimens, the question as to specific or sub-specific rank of certain little known fishes of the Arctics must be held in abeyance".

Preceding this quotation Mr. Soper, in his book, himself supplies the information regarding the localities where the specimens of the various fishes, including the charrs, were obtained.

(7) THE ARCTIC GRAYLING (*Thymallus signifer*)

This conspicuous fish of the north, is especially distinguishable from all other salmonoids inhabiting the waters of Canada by the extremely high and ornamental dorsal fin, which moreover is brilliantly coloured. The fin is dark gray in colour with paler reflections, and with blue spots set more or less in rows, and which are edged with red. The back of the fish is of a purple colour, and the under parts blackish or grayish, variegated with whitish, and there are blue spots on the body of the fish. The head is brown in colour with a blue mark on each lower jaw, and the ventral fins are variegated with whitish and reddish. It occurs in waters of the northern part of British Columbia, in the Mackenzie river, and in waters of Alaska to the Arctic ocean; and has besides been recorded from Great Slave lake, Great Bear lake, Winter River region, and the Churchill river or its tributaries. It may reach a length of about a foot and a half.

Mention is made here of a species of grayling (*Thymallus tricolor*) still existing in streams of the state of Michigan, and possibly to be found on the Ontario side of St. Marys river. There is something very interesting in a study of the records of this grayling. Indeed, Cuvier and Valenciennes in the year 1848 bestowed upon it the technical name of *Thymallus ontariensis,* and the latter wrote concerning the specimen (or specimens) which had been sent by M. Milbert: "We have received from lake Ontario a *Thymallus* very near to that of the lake of Geneva". We may therefore inferentially consider that its former range was much wider than it is now, and Doctors Jordan and Evermann say: "It is being rapidly exterminated through the influence of anglers and sawmills." Furthermore, these authorities also say: "These Michigan localities evidently represent a detached colony, left from the former post-Glacial extension of the range of *T. signifer* of which this was once a variety". Without attempting a diagnosis of the features of this fish, it may suffice to say, that instead of the exceedingly high dorsal fin of the preceding, the dorsal fin of the Michigan grayling is only of moderate height. There is also a variety of this species (*T. tricolor montanus*) still existing in the border state of Montana, and also in the Yellowstone National Park.

(8) SMELTS AND THE CAPELIN AND THE OOLACHAN OR CANDLEFISH

The group we have now to consider embraces small, or even drafted, salmonoids. They are mostly marine, some of them spawning in the sea or in the surf, but some of them enter rivers to spawn, and there are also landlock instances

among them. With the exception of the genus *Retropinna* of New Zealand, all the species are confined, as the salmonoids in general are, to the northern hemisphere.

The American Smelt *(Osmerus mordax)*

The smelt affords a stable and lucrative industry at our Atlantic coast, and is fished for through the ice in the winter time. It is an excellent panfish of fine flavour. It enters streams from the sea to spawn, but regularly returns to the sea with the outgoing tide. It goes far up the streams, and I have seen its eggs lying in great numbers in brooks in New Brunswick a long way up; but I have also seen them in a brook where it empties directly into the bay at Port Hillford, Guysboro county, Nova Scotia, and have even seen them near the mouth of a brook adjacent to Buctouche in the former province which became covered by the incoming tide. It is not however, apart from its spawning habits, strictly a marine fish, for it also exists landlocked in fresh water lakes in New Brunswick, Nova Scotia, and the state of Maine; and whilst engaged in some fishery matters in the month of May, 1903, I even found some dead dwarfed specimens floating on the surface of the water in lac des Isles in the Gatineau district in the province of Quebec, which lake is distant some sixty miles north of Ottawa, and which is therefore a long way off from the sea. Its coastwise distribution is from Labrador to Virginia. In colour the smelt is greenish above and silvery on the sides, and the body and also the fins are beset with fine dark spots. In this fish the lateral line is interrupted, and does not extend much beyond the pectoral fins when extended upon the sides. It may attain a length of about one foot.

The Rainbow Herring *(Osmerus dentex)*

In some respects this species is closer to the American smelt than it is to the Pacific smelt, and will therefore be considered next. It is unfortunate that the name "herring" for this smelt is again erroneously applied to a salmonoid, and this misnomer could only be rectified by calling this little fish the rainbow smelt. It occurs in the Naas river in British Columbia, and has been recorded by Preble from the Arctic Red river; and ranges from Alaska, embracing both coasts of the Behring sea, to northern China. Like the American smelt it inhabits fresh water as well as the sea, but unlike the latter it is brilliantly coloured. It is olive on the back, the edges of the scales being darker. The sides and under parts are very variegated. It is purple above the lateral line and blue below that line, changing again to violet or golden, and yet again to silvery tinted with rosy, and finally below to beautiful white. The fins are plain in colour, but with a golden reflection.

The Pacific Smelt *(Osmerus thaleichthys)*

The Pacific smelt occurs in British Columbia, and ranges from California to Alaska. It attains a length of about nine inches. It spawns in the sea. In colour it is olivaceous with silvery sides, and is translucent in appearance.

The Surf Smelt *(Mesopus pretiosus)*

This is another Pacific coast species, and ranges from British Columbia to California. It stands, with one or two other species (*M. olidus* of Alaska, Kamchatka, and northern Japan; and *M. japanicus* of Japan) in a genus apart from that of the typical smelts. It is about one foot in length, and is olivaceous in colour with a silvery band along the side. It spawns in the surf. Points of distinction, among other points between the surf smelt and the typical smelts concern the character of the teeth, and the position of the ventral fins.

The Argentine or Siel Smelt *(Argentina silus)*

This fish occurs at the Grand Banks off Newfoundland, and also occasionally on the coast of Maine, and off the coasts of northern Europe. A rather curious instance of its occurrence in Canadian waters was a specimen found in the stomach of a codling, or so called hake, off Sable island, Nova Scotia. The colour of the Argentine is olivaceous with silvery sides, and it attains a length of about seventeen inches.

The Deep-sea Smelt *(Bathylagus pacificus)*

Mention of this little known fish is made on the strength of two specimens having been obtained, by United States deep-sea explorations, in 685 and 877 fathoms off the coast of the State of Washington; so that sometime it may very probably be found to occur in deep water off the British Columbian coast. Fishes inhabiting great depths are usually dead when brought to the surface as they require the water pressure, but this fish when alive, apart from phosphorescent conditions, practically dwells in darkness, and is thought to be wholly black in colour.

The Capelin *(Mallotus villosus)*

Although the capelin is essentially a fish of the polar seas, it is uninterruptedly very widely distributed from the north to both the Atlantic and Pacific coasts, ranging to cape Cod of the former and to British Columbia of the latter, and it also extends on the Asiatic side of the Pacific to Kamchatka. Doubtless, in its distribution in the temperate zone, it is a survivor of the Glacial period. Moreover, not only has it still a wide geographical distribution but also an interesting geological distribution, and at Green's creek on the banks of the Ottawa river there are nodules of clay containing fossil remains of the capelin in a high state of preservation, and similar nodules have been found in Greenland. It is a close relative of the oolachan which we have next to consider. In colour the capelin is olivaceous above and silvery on the sides and beneath, and there are dots on the opercular covers. It spawns in the surf, and the newly hatched out young ones present the phenomenon of a quivering mass upon the beach, where they await the return of the tide to transport them into the sea. The males, in addition to the ordinary scales, have elongated scales upon the lateral line and on the under part of the body. The flesh of the capelin is of good flavour, and it may reach a length of about nine inches.

The Oolachan or Candlefish *(Thaleichthys pacificus)*

This is quite a remarkable fish on account of the quantity of oil in its flesh, which at ordinary temperatures is said to be of the consistency of lard. Moreover, the excellent flavour of its oil and flesh renders it as a pan-fish a choice article of food, and it has even been turned to singular use by converting the entire fish into a candle—hence its name of candlefish. It occurs in great plenty in the Naas river in British Columbia and also occurs in the Fraser river, and ranges from Oregon to Alaska. It is of a whitish ground colour, the upper parts being covered with dark marks. It attains a length of about one foot.

Notes supplied for this work by Mr. J. A. Rodd, Director of Fish Culture of the Federal Fisheries, concerning "Introductions of Non-indigenous Salmonoids in Recent Years."

Eastern Whitefish

Whitefish from lake Winnipeg have been introduced into Big and Little Quill lakes, Saskatchewan, and into Okanagan lake, British Columbia. They were not previously found in these waters. The whitefish have done well and

quite a number have been taken in the Quill lakes during the last two winters. There is no proof, however, that the fish have reproduced in these waters, which are strongly alkaline. This feature is being investigated. The first and very small distribution was made in Okanagan lake about thirty years ago. Quite a number were taken in test fishing during the past winter. They have undoubtedly reproduced in their new environment.

Cisco or Lake Herring

The cisco or lake herring that are found in considerable numbers in the autumn in the bay of Quinte and in Thunder bay, lake Superior, have been introduced into Quill lakes. They have done well. Quite a number are being caught, but there is no evidence that they are reproducing. This feature, however, is being investigated.

Atlantic Salmon

Considerable numbers of Atlantic salmon have in recent years been distributed in the Couichan river, Vancouver island, and its tributaries. The species in various stages of development from smolt to mature fish on their return from the sea have been caught. The number, however, is not in proportion to the distributions that have been made. The reasons for there not being a larger return are being investigated.

Rainbow Trout

This species has been successfully introduced and is reproducing in Pisquid lake, Prince Edward Island. The growth obtained in this lake is rather remarkable, and many specimens from two to four pounds in weight were caught two years after the first introduced fry. These fish are reproducing, and eggs have been collected in two different seasons. Rainbow trout have also been successfully introduced into numerous streams in the foothills of Alberta between Calgary and the international boundary. They have done extremely well, are thought highly of by anglers, and in some waters in 1927 about one out of three trout landed was a rainbbow.

Brown and Loch Leven Trout

Brown and Loch Leven trout have been successfully introduced into the several streams that rise in the Cypress hills and flow into Cypress lake in southwestern Saskatchewan and into Loch Lomond near St. John, New Brunswick. They are also introduced into the tributaries of the Red Deer and Saskatchewan rivers in Alberta. Specimens up to five pounds in weight have been taken in Cypress hills waters and many individuals of large size are taken annually in Loch Lomond.

Eastern Speckled Trout

This species is being introduced into Medicine-Maligne Lake system in Jasper Park. The first distribution was made in 1928, and the second will be made shortly.

In addition to the above mentioned, numerous transfers and distributions of a minor nature are being made annually.

4. VIPER FISHES AND THEIR ALLIES

These, in classification, are included in a curiously modified but diversified group, mostly of pelagic and bathybial or deep-sea fishes, embraced under the general name of lantern fishes. Many of them possess phosphorescent luminous organs to lighten their way in the abysmal darkness. Owing doubtless to a more uniform temperature at great depths, some have been recorded from very extreme, or opposite, parts of the ocean. Of two occurring at the Grand Banks off Newfoundland, one *(Sternoptyx diaphana)* has also been recorded from

Jamaica and from off the Hawaiian and Japanese islands, and the other *(Argyropelecus olfersi)* from the coasts of Brazil, cape of Good Hope, and Norway; and both of these species have the habit at night time, or during stormy weather, of rising toward the surface of the sea. A bathybial species *(Stomias ferox)* recorded from East Banquereau, ranges according to records from Greenland to the Bahama channel, and another *(Malacosteus niger)* a specimen of which was obtained on the northeastern edge of George's Bank by the schooner *Alice G. Wonson* in 125 fathoms, occurs in the gulf Stream southward to the Barbadoes. A specimen of a viper fish *(Chauliodus sloanei)* indigenous to the Atlantic in the depths, and in the Mediterranean, was found in the stomach of a codfish at George's Banks in latitude 42° 08′ N, longitude 65° 35′ W., in 185 fathoms; and the following concerns a viper fish, the type specimen of which was found in our own waters. The above words are written, in order to draw attention to what may in the future be expected to be brought to light concerning fishes inhabiting the great depths.

The Viper Fish *(Chauliodus macouni)*

This viper fish received its technical name *macouni* in honour of the now deceased Professor John Macoun, the eminent Canadian naturalist. The type specimen was obtained off the Queen Charlotte islands, British Columbia, in 876 fathoms; and the species is now known from a very few specimens, from deep water, to apparently extend to the coast of California. It is very close to *Chauliodus sloanei* of the Atlantic, mentioned above. Both possess long fang-like teeth, they have luminous phosphorescent spots, the first dorsal fin is high, the first ray of which is elongated and filamentous, and the second dorsal is adipose. Both are very voracious fishes, inhabiting the depths.

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